with Dr. L. E. Shore, made an interesting contribution to pharmacology,[7] showing that chloroform lowers blood pressure by acting directly upon the heart, and not on the vasomotor center, as had hitherto been supposed.

Gaskell was an unassuming, sympathetic character, and it is said that every physiologist who has worked in the Cambridge Laboratory since its start was his personal friend. His eminent colleague, Professor J. N. Langley, thus describes him:

> Gaskell cared little for public ceremonies, and rarely attended the congresses which beset the path of prominent scientific men. He loved to work quietly, to cultivate his garden, to see his friends, and to take a hand at whist or bridge. His house at Great Shelford was a recognized meeting-place for physiologists, and his frank and genial welcome will be an abiding recollection to all who knew him.

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DR. GASKELL'S WORK ON ORGANIC EVOLUTION

IT is not with any idea of writing an appreciation either of the man or of his work as a whole that I venture to present this sketch. His work within the limits of the narrower field of physiology—the observations on the effect of a rise in tension of the muscles upon the caliber of the lymphatic vessels, the long series of experiments upon the relation of the vagus and accelerator nerves to the heart and on cardiac muscle, the work on the nerves to the salivary gland—has been dwelt upon by others.[1] I wish rather to call attention to some of the unusual features, and their bearing on the wider biological problems of the day.

Gaskell's work on the origin of vertebrates was begun under conditions that most investigators would consider unfavorable. His wife became afflicted with an obscure nervous disorder, not diagnosed at that rather early date, and his presence was required more and more at his home. Not wishing to give up investigation during his enforced absence from the laboratory, and having his attention turned toward the central nervous system, he began to enquire into its origin and development in the various animal phyla. Regarding the nervous system as the fixed and permanent structure in phylogenetic development, he concluded that the alimentary tract might be the thing to be made over in the transition from the invertebrate with ventral nerve cord to vertebrate with its dorsal nerve cord, and drew up his scheme of the origin of the vertebrates on this basis. Although Gaskell has brought together a vast amount of evidence bearing on this point,[2] his theory has been treated with scant courtesy by most morphologists. It is a common occurrence to hear it glibly and vigorously condemned by people who have never read his book or weighed independently for themselves the evidence adduced in support of the theory. It is worthy of remark in this connection that Gaskell was a pioneer worker in a line which has led in very recent years to the development of a large and important field in the morphology of the central nervous system—the field now included in the component theory of nerves. And he has shown in a way which has had its influence upon other theories of the origin of vertebrates, that the older idea of the formation of a new nervous system while the alimentary tract remained intact in phylogeny is not an assumption to be made lightly. But whether the theory of the origin of vertebrates as he propounded it be right or wrong, a matter which I venture to regard as still unsettled, certain of Gaskell's conceptions of the nature of fundamental biological processes are firmly and surely grounded. It is of these that I wish more particularly to speak.

Gaskell recognized very clearly the importance of the rôle played by internal processes in evolution. In 1910, he wrote:

> Now the formation of the Metazoa from the Protozoa and the progress of the Metazoa upwards signifies that the separate units composing

[7] Lancet, Lond., 1893, I., 386.

[1] Langley, *Nature*, 1914, Vol. 94, No. 2343, p. 93. *British Medical Journal*, 1914, No. 2804, p. 559.

[2] Gaskell, "The Origin of Vertebrates," New York and London, 1908.

the individual have been coordinated for the well-being of that individual. Such coordination has taken place in two ways: (1) a chemical method, by the formation of hormones; (2) a nervous method, by the formation of a central nervous system, and it is self-evident that as soon as a central nervous system is formed, such nervous coordination, especially in connection with the formation of the special senses of sight and smell, must become the important factor in the life of the individual, and its further and further development must constitute the most important factor for the upward progress of the animal race.[3]

The fundamental importance of this idea is likely to be lost for the general reader in the almost platitudinous simplicity of the statement. In reality, there is much matter for long and profound reflection. The idea of chemical coordination, although of comparatively recent development, has claimed the attention of a host of workers, partly perhaps because of its novelty, and the nervous mechanism has, by contrast, become a neglected field. But in the development of the purely chemical mechanisms of coordination, so far as they have been traced at present, we find that they reach their maximum efficiency and complexity well down in the mammalian phylum. It is probable that, so far as the purely chemical mechanisms are concerned, man is not a more complex animal than the rabbit, and certainly not a more complex animal than the dog. Yet the total difference between man and the rabbit or the dog is considerable. The reason for this difference is not far to seek. It lies in the difference of the nervous systems of the two forms, and in the interaction of this system with the chemical mechanisms of coordination. After the chemical mechanisms have reached their zenith, the nervous system still shows, step by step, an increasing complexity, functionally as well as structurally, as successively higher types of animals are examined.

I walked out to Dr. Gaskell's house from Cambridge early one August afternoon two years ago, intending to make a brief call, but the afternoon was far gone and the sun low in the west before I started for the little railroad station at Great Shelford. The conversation turned on the rôle of the internal factors in evolution. He remarked:

> It is not size, it is not strength, that has conferred the great advantage in the struggle, but acuteness.

The hand and arm of man are often cited as adaptations of a high degree of perfection conferring a great advantage upon its possessor. This is but a part of the story. The hand and arm without a nervous system to control or coordinate its movements would be valueless. The hand and arm of a recent hemiplegic may have lost little or nothing in bone or muscle, but, despite its complex structure, it is of less use to its possessor than the foreleg and hoof of a horse. The clot of blood in the cerebrum has wrecked the mechanism which also is necessary if the marvelous hand of man is to be of use to him in the struggle for existence. Nor would the combination of the man's hand and the dog's brain be a more happy one. The feeble-minded and the idiotic often show but slight and unimportant physical modifications aside from those found in the brain. When looked at from the point of view of its functional relations to the whole organism, or from the point of view of its use to the possessor, neither hand nor motor nervous system alone is significant, but it is the combination of the two—the coordination—that is the important thing. And in addition to the mere manual skill arising from the steady nerves and the strong hand, the faculty of looking into the future—the acuteness and accuracy of mental vision—constitutes a valuable adjunct to the possessor of an organism whose chemical mechanisms of coordination give rise to no physical discomforts. The nervous mechanisms of coordination, as well as the chemical, will surely claim the serious attention of the student of evolution from its functional side. And it is not single structures or organs alone which become significant in evolution, but the coordination of all parts of an organism.

[3] *Proceedings of the Linnean Society of London*, Session 122, 1909–10, p. 9.

One corollary may be drawn from this main proposition. From the point of view of its function, neither the hand as a whole nor any of its parts which become of any real significance can be regarded as a unit character. In the inception of the character there must have been some changes in the nutrition of the tissues—some change in the chemical mechanism of coordination—rendering such a departure possible, and such a change in a chemical system seldom arises without some associated change in conditions, near or remote. And when the character has developed to a stage at which it becomes significant, it acquires this significance only because it may enter into correlated or coordinated activity with other parts of the organism through the medium of chemical or nervous mechanisms, or both. It is difficult for a physiologist to regard any one portion of the body as an isolated mechanism acting without reference to any other mechanism. The tendency to regard a mechanism as an isolated mechanism has often led into error. And the attempts by experimental methods completely to isolate any mechanism so that it acts independently of every other has proved to be a difficult and for the most part impossible process under present laboratory conditions. In the living animal under its various conditions of existence, coordination is an indispensable process. And since the processes of evolution are concerned with living animals rather than dead ones, the mechanisms of coordination become the important factors in evolution. For it is these internal factors which modify in greater degree than any others the growth and development of the organism in any environment in which life is possible.

That Gaskell clearly recognized the importance of coordination and insisted upon it is clear from the extract quoted above. To recognize clearly amid the multiplicity of confusing detail the fundamental factors in organic evolution regarded from its functional side, is a noteworthy achievement. And to state the problem in terms of biological phenomena rather than in metaphysical terms is to give to other biologists a fruitful working hypothesis. It is with a poignant sense of a personal as well as a scientific loss that many of us have read the recent announcement of his death. A kindly, sturdy, clear-eyed Briton, England need have little fear for the future of its science if she can produce more of his like.

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THE PHILADELPHIA MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE AND AFFILIATED SOCIETIES

THE preliminary announcement for the meetings of the American Association and those of the Affiliated Societies which will meet with it at Philadephia during the coming convocation week has now been sent to members. The arrangements for the meeting are well under way and a strong local committee has been appointed, of which Provost Edgar F. Smith is chairman, Dr. J. H. Pennimann is vice-chairman, Dr. Philip P. Calvert is secretary, and Dr. George D. Rosengarten is chairman of the finance committee.

The first meeting of the council will be held on Monday, December 28, at 9 A.M. in the council room at Houston Hall. Registration will be held from 9 A.M. to 5 P.M. each day at headquarters in the Houston Club. The sections will meet for organization at 10 A.M. on Monday and will continue their sessions during the week.

The first general session will be held in Weightman Hall, university gymnasium, at 8 P.M. on Monday, December 28. The meeting will be called to order by retiring president Edmund B. Wilson, of Columbia University, who will introduce the president of the meeting, Dr. Charles W. Eliot, of Harvard. Addresses of welcome by the provost and the governor-elect will be replied to by President Eliot, after which retiring President Wilson will deliver his address on "Some Aspects of Progress in Modern Zoology."

There will be two public lectures, complimentary to the citizens of Philadelphia and